



## Using Satellite Remote Sensing and Modelling for Insights into NO<sub>2</sub> Air Pollution and NO<sub>x</sub> Emissions.

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Nitrogen oxides (NO<sub>x</sub>) are key actors in air quality and climate change. Satellite remote sensing of tropospheric NO<sub>2</sub> has developed rapidly with enhanced spatial and temporal resolution since initial observations in 1995. We have developed an improved algorithm and retrieved tropospheric NO<sub>2</sub> columns from Ozone Monitoring Instrument. Column observations of tropospheric NO<sub>2</sub> from the nadir-viewing satellite sensors contain large contributions from the boundary layer due to strong enhancement of NO<sub>2</sub> in the boundary layer. We infer ground-level NO<sub>2</sub> concentrations from the OMI satellite instrument which demonstrate significant agreement with in-situ surface measurements. We examine how NO<sub>2</sub> columns measured by satellite, ground-level NO<sub>2</sub> derived from satellite, and NO<sub>x</sub> emissions obtained from bottom-up inventories relate to world's urban population. We perform inverse modeling analysis of NO<sub>2</sub> measurements from OMI to estimate "top-down" surface NO<sub>x</sub> emissions, which are used to evaluate and improve "bottom-up" emission inventories. We use NO<sub>2</sub> column observations from OMI and the relationship between NO<sub>2</sub> columns and NO<sub>x</sub> emissions from a GEOS-Chem model simulation to estimate the annual change in bottom-up NO<sub>x</sub> emissions. The emission updates offer an improved estimate of NO<sub>x</sub> that are critical to our understanding of air quality, acid deposition, and climate change.